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TITLE: Special Memorandum

SUBJECT: Report on the 1947 Emergency (R.&M.A.) Corn Project

In view of the interest in the 1947 emergency corn program (RMA Project No. 1), the attached summary has been prepared to inform statisticians and others of the methods and procedures used in carrying out this project, as well as the results obtained. Although weather conditions this season have been such that a project of this kind has not been needed, the experience gained last year will be invaluable in planning future surveys when, and if, they are needed. This was a new type of project and much pioneering work had to be done. Although it was not a formal cooperative project, the resources of Experiment Station officials, Agricultural Colleges and Government and private agencies, such as hybrid seed companies, were used. We would be glad to have any comments you wish to make regarding the attached report.

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Enclosure - 2 reports to each State.

SEP 8 1948

Report on the 1947 Emergency (RMA) Corn Project 1/

Purpose of Project: The beginning of the 1947 corn season had all the earmarks of a "soft corn" year. "Soft corn," for the purposes of this project, was defined as being corn frosted before reaching maturity (35% moisture content). Extremely adverse weather resulted not only in a smaller acreage of corn than was intended, but also in greatly delayed plantings, thereby threatening to affect seriously both the quantity and quality of the 1947 crop. The situation appeared critical because of heavy demands for feed and food in this country and in western Europe, corn being the most important feed crop grown in the United States. As a result, an emergency corn project was set up, the specific objectives of which were to provide means for using weather and phenological factors for establishing the probable amounts and geographic location of "soft corn," moisture content, and other factors relating to the 1947 crop and to issue timely reports with respect thereto. The project was in effect in 12 States: Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, Ohio, South Dakota, and Wisconsin.

Methods and Techniques Used: The first phase of the program was to collect planting data. A special mailed inquiry relating to the percentage of total acreage planted before June 1, between June 1 and June 15, between June 16 and June 30, and after July 1 was sent to crop reporters about July 15. The weekly crop-weather surveys, which were being conducted in some of the States, provided some information on planting dates. In these States, the special survey also served as a check on the progress of planting shown by the crop-weather surveys. The planting data provided a basis for estimating the percentages of the total acreages which were planted by specified dates. These data served two purposes:

1. Provided a quantitative appraisal of lateness of the 1947 crop. It was necessary to have some basis for determining the actual lateness of the crop in order to evaluate both current and subsequent weather effects. It was, of course, known that the 1947 crop was late, but a special survey was necessary to determine the actual degree of lateness. This survey indicated that the planting season was extended 2 to 4 weeks longer than usual.
2. Provided a basis for approximating silking dates. By projecting planting dates by the estimated time from planting to silking, which varies considerably among and within States depending upon varieties and other factors, an approximation was made of the probable silking dates. These expected silking dates were revised as the season progressed and weather continued to depart sharply from average.

The next step in the program consisted of obtaining actual silking dates. These data were collected weekly beginning as of August 8 and continuing until 90 percent of the corn had silked in a State. Two sources were used for collecting silking data:

1. Special mailed inquiries relating to the cumulative percentage of the total acreage that silked each week were sent to crop reporters.
2. Field observations by State statisticians. Data collected in this matter supplemented the results obtained under (1) above.

The silking dates, together with information obtained from weekly crop-weather surveys in some States, served two purposes:

1. Provided a means for checking the validity of methods used for estimating silking dates, i.e., projecting the planting dates by the estimated period from planting

to silking and adjusting these estimates as weather conditions warranted. The continuation of wet, cold weather for several weeks after the normal planting time tended to extend the planting-silking period. However, this was partly offset by hot, dry weather in July, which caused corn to develop faster and silk several weeks earlier than expected.

2. They were used for determining the actual percentages of corn acreages reaching this important phenological stage (silking) by specified dates. Previous experience at Experiment Stations, Statistical Laboratories, and other sources had indicated that silking dates might be effectively used as a benchmark in estimating the time of physiological maturity of corn. This is true because the period from silking to maturity is known to be fairly constant. Radical weather departures have some effect during this period, but are much less pronounced than during other growth periods. After establishing the dates on which the various percentages of the crop had silked, an estimate was made of the probable dates on which these percentages of the crop would reach maturity. This was done by projecting the silking dates by 50 days, the estimated average period from silking to maturity.

After estimates of maturity dates were made, the next step was to devise means for estimating the probable percentages of the crop that would be frosted before maturing (35 percent moisture content is considered mature corn). The crop is always subject to some frost hazard, the degree depending primarily upon the lateness of the crop and the time of first killing frost.

An estimate of the likelihood of frost by the expected maturity dates was needed. However, this type of information was not available. Average frost dates were available, but the variability of frost dates from year to year and the probability of frost by certain dates was not known.

In order to determine the frost probabilities needed, the best approach seemed to be to obtain data relating to the first killing frost at selected Weather Bureau stations in the various areas of each State. After assembling these data, they were converted to a percentage frequency and accumulated so that the chances of frost by any desired date could be approximated. Frost probability charts, constructed on this basis, were prepared and forwarded to the States concerned. Data relating to the estimates of corn acreage not expected to be mature by specific dates were likewise entered on these charts. These charts, containing frost and maturity data, provided a basis for estimating the likelihood of any given percentage of the crop being "caught", assuming frost on any specified date. An example of the way the chart was used: On the attached chart assume that 19 percent of the corn acreage had silked by August 14. This means that 81 percent of the acreages would not be matured by October 4--the silking date projected by 50 days, the estimated period from silking to maturity. Looking at the frost line on the chart for October 4 there would be a 19 percent chance (19 chances out of 100) of frost by this date (October 4). Similarly, if it is assumed that frost would occur on the average date (October 15), there would be a likelihood of 28 percent of the corn acreages being caught by frost.

Estimates were made and included in the periodic releases of the quantity of corn expected to be frosted in each State if frost occurred on the average date, one week before the average date or one week later than the average date.

As the season progressed, it became desirable to determine the actual stage of development, or maturity classification, of all corn. This provided a check on reliability of the maturity estimates previously made and served as a basis for revising these estimates when necessary. Corn matured one to two weeks earlier than was indicated earlier in the season because of unusually hot, dry weather during late summer and early fall. Weekly releases showed the percentages of total

crop in various maturity categories, i.e., mature, dent, hard dough, soft dough, milk, not yet in milk, and no ear formed. Efforts were made to identify certain physical characteristics, such as the starch content, the position of lines around the grains, etc., associated with each class. This resulted in general uniformity among States in methods of classifying. The particular maturity classes used were selected after conferring with State statisticians, Experiment Station officials and others who had experience in studying the physiological stages of development associated with various maturity classes. The following methods were used in making these maturity estimates:

1. Mailed inquiries were sent to crop reporters each week, beginning September 12 and continuing until about the first killing frost in a given State. These surveys provided an indication of the farmer's locality judgment of the percentages of corn in each maturity class on specified dates.
2. Roadside tallies of fields, by maturity classes, were made by the State statistician along pre-determined routes.
3. Fields were randomly chosen, by selecting every nth field along certain roads, for the purpose of drawing ear samples for moisture testing. The classification by maturity classes of these fields provided an additional indication of maturity stages.
4. Sample segments were randomly drawn from the fields selected (under 3 above) for the purpose of selecting ear samples to be tested for moisture content. The ears in these segments were classified as to maturity.

The methods for determining maturity under 3 and 4 above were used only during the week (several weeks in some States) in which samples were selected and tested for moisture content.

It was necessary to obtain an estimate of the average moisture content associated with each class in order to estimate the moisture content of all corn as indicated by the weekly maturity surveys. This was done by making actual moisture tests of samples selected in each maturity class. The sampling rate for drawing samples for each maturity group from the segments was determined from the estimated percentage of corn in each maturity group. These tests were made during at least one week in each State in cooperation with PMA, Weather Bureau, Agricultural Colleges and others. They were made either with electric equipment, oil bath equipment, or open-oven, depending upon the facilities of the cooperating agencies. Washington men assisted in some States with the gathering and testing of samples.

A study was also made at the Ames, Iowa Statistical Laboratory as a part of this project. The Ames study was primarily designed to supplement, by objective methods, the data collected on this overall project. It involved the use of experimental plots consisting of seven replications on land chosen for average and uniform soil characteristics. Three varieties of corn were used--early, medium, and late. The results of this study indicate that:

1. Maximum dry weight is probably the most effective guide for determining maturity.
2. A constant dry weight ratio was reached about 50 days after silking for all varieties.
3. All varieties did not reach maturity at the same moisture content, assuming a constant dry weight ratio by maturity.
4. The later the variety the later it tasseled. The time rate of tasseling was almost constant for all varieties.

5. The later the variety the later it silked. The time rate of silking was about the same for all varieties.

6. The intervals from planting to emergence and tasseling to silked were nearly constant for the three varieties.

7. The interval from emergence to tasseled became longer as the variety became later, accounting for at least a part of the lateness of the variety.

8. Dry weight has a much larger variance than moisture content.

A report on the Ames study is on file in the Washington office.

Conclusions: The techniques used in this project proved to be generally successful. The use of several independent methods for determining phenological stages afforded confidence in the estimates made for each. The methods used in determining maturity classes and collecting and testing samples for moisture content met with the general approval of all concerned. There was considerable interest in the periodic releases, being generally agreed that the type of information provided met the needs of the trade, Government officials and others.

The "soft corn" threat did not materialize except in parts of Iowa, Indiana, Michigan and Ohio, where frost occurred "locally" somewhat earlier than usual. Estimates of the amount of soft corn that actually did occur were in close agreement with that indicated by the frost probability charts, assuming frost on the dates on which it first occurred, adjusted because of the unusually hot, dry weather during the latter part of the summer and early fall.

The results of a rather extensive "semi-controlled" mailed survey, conducted in January 1948, substantiated the "soft corn" areas mentioned above. About 14,000 schedules were sent to farm operators who were interviewed during the January 1947 Enumerative Survey--almost 8,000 usable schedules were returned. Farmers were asked to report the percentage of their 1947 corn for grain crop that was (a) sound, (b) chaffy, (c) of poor keeping quality. There was close agreement between the areas from which relatively high percentages were reported under (c) and the areas previously identified as containing significant quantities of immature corn when frost occurred. A question on the feeding quality of the 1947 corn crop was placed on the January 1948 General Schedule. The reported areas of poorest quality coincided rather closely with the previously established soft corn areas. The relatively small quantities of soft corn in 1947 may be attributed to at least two factors:

1. Frost occurred somewhat later than usual in most areas, thus extending the development period.
2. Hot, dry weather during late summer and early fall shortened the silking-maturity period, which usually consists of about 50 days to 45 or less. A large part of the corn was "forced to maturity" resulting in light, chaffy corn rather than soft corn.

It was assumed that the feeding quality of corn was best in areas where corn was nearest to maturity at the time of frost and poorest in the "soft corn" areas. However, it would be desirable to make sample test weights and shelling percentage tests in future surveys to more definitely establish the relation between the feeding value and the moisture content of corn before and at the time of cribbing.

- Suggestions and constructive criticisms regarding this project were made by field statisticians and others for consideration when and if future surveys are conducted. Specific suggestions were:
1. In States where weekly crop-weather surveys are in effect, the phenological data now being collected, especially that relating to planting and silking, may be sufficient for establishing the required phenological dates without conducting special surveys.
 2. Use tasseling instead of silking as a benchmark for estimating the time of maturity. Tasseling appears easier to identify and the period from tasseling to silking is almost constant, normally being about one week from the time of first tassel to full tassel and only one or two days from full tasseling to full silking. It is the consensus of many who participated in this program that there would be less chance of error in reported tasseling dates than silking.
 3. Additional research is needed for evaluating the relation between phenological and weather factors and the variability in the length of the periods between various growth stages. The experience during the 1947 season indicated that the length of the periods between various growth stages is largely dependent upon weather conditions. This was evident even in the silking-maturity period, which is the most stable and less affected by weather.
 4. It is the opinion of many statisticians who participated in this project that future projects should relate only to the "corn for grain" segment of total production where uses for other than grain are relatively unimportant.
 5. Devote more study to definitions and numbers of maturity categories needed. The "no ear formed" category should perhaps be deleted from future surveys. This category is confusing because it carries two connotations, the first of which refers to corn not yet advanced sufficiently for ears to have formed and the latter to corn not developed fully because of weather or other conditions. It is possible that the 7 maturity categories used in this survey could be consolidated into four, with rather specific limitations, i.e., moisture ranges and physical characteristics defined for each category.
 6. Supplement the Weather Bureau Stations used in determining frost probability charts with additional stations. The accessibility of records of the stations used, together with the fact that the ones chosen appeared reasonably representative, prompted their use. It was realized at the time, however, that a larger number of stations would have given somewhat more precision in frost data. However, the results of a contemporary study conducted by the Weather Bureau involving the use of a large number of stations were in close agreement with those used in preparing our charts.
 7. Arbitrarily select corn ear samples for moisture testing rather than make a random selection. An exploratory study made in one of the States participating in this program indicated that it might be feasible to arbitrarily pick representative ear samples in each of the maturity categories for moisture testing purposes rather than randomly select such samples. This approach needs to be explored further, and if proved satisfactory, it would greatly simplify this phase of the work.
 8. Future surveys should involve plans for obtaining data on test weight and using such data in conjunction with moisture content so as to indicate the degree of storageability and feeding value.

